

MIL-STD-1660

8 APRIL 1977

MILITARY STANDARD

DESIGN CRITERIA FOR

AMMUNITION UNIT LOADS



FSC 8140

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer Naval Ordnance Station, Standardization Department, Code 611, Indian Head Md. 20640, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
Washington, DC 20362

Design Criteria for Ammunition Unit Loads

MIL-STD-1660

1. This Military Standard has been approved for use by all Departments and Agencies of the Department of Defense and is published to establish Design Criteria for Ammunition Unit Loads.
2. This is a mandatory standard for use by DoD ammunition design activities and when applicable is to be invoked in specifications, purchase descriptions and/or contracts when such design service is to be procured. It applies to ammunition terms as prepared for shipment and not necessarily to metal parts, bulk explosives and other components.
3. Recommended corrections, additions or deletions should be addressed to Commanding Officer, Naval Ordnance Station, Standardization Division (611), Indian Head, Maryland 20640.

6 June 1978

MILITARY STANDARD

DESIGN CRITERIA FOR
AMMUNITION UNIT LOADS

TO ALL HOLDERS OF MIL-STD-1660:

1. Make pen and ink changes or add new paragraphs to the following pages.

Cover page:

Delete "Beneficial comments" statement.

Page ii:

a. Change "Department of Navy, Naval Sea Systems Command" to "Department of Defense."

b. Delete paragraph 1 and substitute:
"1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense."

c. Delete paragraph 3 and substitute:
"3. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Ordnance Station, Standardization Division, Code 6111, Indian Head, MD 20640, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter."

Page 3.

a. Add to top of page 3:
"STANDARDIZATION AGREEMENT"

STANAG 2828

Military Pallets, Packages and
Containers.

(Applications for copies should be addressed to: Superintendent of Documents, US Government Printing Office, Washington, DC 20402.
Note: Issue-controlled, release to other than DOD Agencies must be approved by the Department of the Army Headquarters, Darcom (Drcird))."

b. Change "Bureau of Explosives" address to:
"1920 L Street, N.W., Washington, DC 20036."

MIL-STD-1660
NOTICE 1

Page 8:

a. Add to TABLE I in the box for Military Airlift after "(half size)", asterisk (*).

b. Add the following explanation for asterisk in box opposite "Military Airlift": " * Logair pallet (HCU-10/C) is not compatible with the C-130, C-141 and C-5 aircraft."

Page 13:

a. Add new paragraph 5.5:

"5.5 Testing. Tests in MIL-STD-1660 fulfill the test requirements of STANAG 2828 and, therefore, may be used in lieu of STANAG 2828."

Page 14:

Replace existing "FIGURE 1" with new "FIGURE 1" attached.

2. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

3. Holders of MIL-STD-1660 will verify that the page changes indicated herein have been entered. This notice will be retained as a check sheet. This issuance is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

Custodians:

Army - AR
Navy - OS
Air Force - 69

Review Activities:

Navy - AS
Air Force - 11

User Activities:

Army - ME, MI
Navy - MC, SH

Preparing Activity:

Navy - OS

Project Number:

8140-0418

FOREWORD

This standard establishes minimum design and evaluation procedures to be applied throughout the Department of Defense to unit loads of ammunition.

When ammunition items, packaged or unpackaged, are moved from one place to another they are usually combined into a larger assemblage which can be easily and safely handled by mechanized equipment; e.g. a forklift truck. This assemblage is called a unit load.

The ammunition logistic system of the Department of Defense is based on distribution in unit loads unless the item, as packaged, is too large or too heavy to be so assembled. A unit load may be stored for prolonged periods before it is needed. It may be shipped by truck, rail, ship or aircraft. Depending upon the particular operations of the consuming combatant unit, the unit load must withstand the rigors of over the beach handling, local transport and handling over rough terrain, or delivery by external or internal carriage by helicopter under the threat of enemy action, or by transfer at sea, or by combinations of these methods, at any time and under poor weather conditions. In addition to possible adverse effects on the reliability of the ammunition, failures of unit loads can lead to death or injury from falling heavy objects or from disastrous explosion. Because of these factors a detailed design must be prepared, tested, and documented showing how the ammunition is to be assembled into a unit load which will be safe and efficient to handle, ship, store, and deliver to the combatant unit.

This standard provides guidelines covering unit loads for ammunition designed to establish reliability, safety and compatibility with handling equipment most commonly found in the distribution system. It is intended to be used in the design and evaluation of unit loads for the end product ammunition line item as distributed to the user, not for those unit loads of inert components moving between contractors as a part of the manufacturing process. The criteria contained herein are not intended to be limiting or restrictive. When justified in individual cases, additional or modified procedures may be used. If deviations from this standard affect handling, transportation, or stowage characteristics, advance notice will be given by the design activity to all services who will handle the unit load.

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SCOPE

1 This standard establishes minimum design criteria and associated tests for ammunition unit loads.

REFERENCED DOCUMENTS

1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

SPECIFICATIONS

Federal

F-N-105 Nails, Wire, Brads, and Staples

M-L-751 Lumber and Timber, Softwood

Q-S-781 Steel Strapping, Flat

Military

IL-A-8421 Air Transportability Requirements, General Specification for

IL-P-15011 Pallet, Material Handling, Wood, Post Construction, 4 Way Entry

IL-P-23312 Pallet, Material Handling, Metal (For Ordnance Items); Mk 3 Mod 0, Mk 12 Mod 0, and Mk 12 Mod 1

STANDARDS

Federal

ED-STD-75 Glossary of Packaging Terms

ED-STD-101 Preservation, Packaging and Packing Materials, Test Procedures

STANDARDS, continued

Military

MIL-STD-444	Nomenclature and Definitions in the Ammunition Area
MIL-STD-648	Design Criteria for Specialized Shipping Containers
MIL-STD-731	Quality of Wood Members for Containers and Pallets

HANDBOOKS

AFSC DESIGN HANDBOOK DH 1-11 Air Transportability

DRAWINGS

Naval Sea Systems Command (Code Ident 10001 & 53711)

564200	Mk 3 Mod 0 Pallet
2086479	Mk 12 Mod 0 Pallet
2645217	Mk 12 Mod 1 Pallet
2644148	Mk 70 Mod 2 Pallet Hoisting Sling
2614969	Mk 85 Mod 0 Pallet Sling
2614970	Mk 86 Mod 0 Pallet Sling
2614971	Mk 87 Mod 0 Pallet Sling
2642587	Mk 93 Mod 0 Pallet Sling
2643919	Mk 100 Mod 1 Pallet Sling
2643725	Mk 77 Mod 3 Container Lifting Sling
2643765	Mk 109 Mod 0 Container Lifting Sling
2642914	Mk 99 Mod 0 Weapons Handling Sling
2643482	Mk 105 Mod 0 Hoisting Sling
2644390	Mk 105 Mod 0 Hoisting Sling Long Leg Assembly

US ARMY

19484138	Basic procedures - unitization procedures for boxed ammunition and components on skidded bases.
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MANUALS

DA PAM 746-1	Pallets for Army use.
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OP 3221 (Army TM 55-607)	Loading and Storage of Military Ammunition and Explosives Aboard Break Bulk Merchant Ships
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(Copies of specifications, standards, handbooks, drawings and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Code of Federal Regulations

46 CFR 146.29-180

Regulations governing the transportation of Military Explosives and Hazardous Munitions on Board Vessels.

49 CFR 170-178

Hazardous Material Regulations of the Department of Transportation

(The Department of Transportation regulations are a part of the Code of Federal Regulations available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Orders for the publication should cite "46 CFR 140 to 149, 46 CFR 150 to 165, 46 CFR 166 to 199, and 49 CFR 100-199".

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI S1.1-1960 (R1971)

Acoustical Terminology (Including Mechanical Shock and Vibration)

ANSI MH 10.1-1972

Unit-Load Sizes for Dimensioning Transport-Package Sizes

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10080).

Bureau of Explosives

Pamphlet No. 6C

Methods for Loading and Bracing Trailers and Less Than Trailer Shipments of Explosives and Other Dangerous Articles via Trailer-on-Flat-Car (TOFC) or Container-on-Flat-Car (COFC)

(Applications for copies should be addressed to the Bureau of Explosives, Association of American Railroads, 2 Pennsylvania Plaza, New York, NY 10001).

3. DEFINITIONS

3.1 General. The terms used throughout this standard are consistent with the following definitions. Packaging terms not defined below are in accordance with FED STD 75. Definitions of shock and vibration terms are in accordance with ANSI S1.1-1960 (R1971). Terms in the ammunition area are in accordance with MIL-STD-444.

- 3.1.1 Batten. A wooden member used to fill space, protect against damage, or to provide additional surfaces for strapping or bearing.
- 3.1.2 Cap. A cover with sides extending perpendicularly from the perimeter used as a protection against damage, or to help create a stable load. It may be used over the load, inverted under a load or used under and over intermediate courses.
- 3.1.3 Edge protector. A light piece of material, used at the edge of a load to prevent damage by strapping.
- 3.1.4 Handling equipment. Any equipment or special handling device used for moving packages, packs, unit loads, containers, items or components.
- 3.1.5 Overhang. The distance that the vertical edges of the components of a unit load extend beyond the edges of the pallet.
- 3.1.6 Pallet. A low portable platform of wood, metal or other suitable material to facilitate handling, stowage and transportation of materials as a unit by mechanical equipment. It is used as the base of a unit load to support and combine groups of commodities (or to confine single items) for handling and shipping as a single entity.
- 3.1.7 Pallet, special purpose. A pallet which is specifically designed for use with a particular ammunition item or for use in a specific handling or transportation environment.
- 3.1.8 Pallet adapter. A wood or metal framework designed to secure irregular shaped articles to a pallet.
- 3.1.9 Palletized unit load. A unit load which uses a pallet as a base.
- 3.1.10 Skid base. A type of pallet used as the base for unit loads of items which are packed in long wooden boxes of 27" in length or greater.
- 3.1.11 Strapping. A length of flat steel, or other suitable material, placed in tension around a unit load to compact and secure the individual items into a single entity.
- 3.1.12 Underhang. The distance the edges of the pallet extend beyond the vertical edges of the items or containers.
- 3.1.13 Unit load. An assemblage of items (in or out of containers) designed to facilitate handling these items as a single entity.

3.1.13.1 Fleet Issue Unit Load (FIUL). A unit load which is specifically designed to permit transfer-at-sea operations and which is compatible with shipboard handling and stowage procedures.

3.1.13.2 Amphibious unit load. A unit load which is specifically designed to be loaded as assault cargo in ships such as LPH's, LHA's and LPD's, for rapid unloading in specific amphibious operations.

3.1.14 Design Activity. The DOD activity responsible for designing ammunition unit loads or, if the design service is procured for approving the design as being compatible with service needs. Example of design activities as defined herein are:

- a. Army: Armament Research and Development Command; Army Ammunition Center.
- b. Navy: Naval Weapons Handling Center, U.S. Naval Weapons Station Earle.
- c. Air Force: Armament Development and Test Center; Ogden Air Logistics Center.

4. GENERAL REQUIREMENTS

4.1 General. This section presents general requirements for unit loads of materials which can be verified by visual observation, simple measurement, or by a certificate of compliance with material requirements. Inspection procedures are concerned only with those materials which are used to make up the unit load; i.e. pallets, adapters, battens, strapping, and the like. Inspection procedures for the ammunition items and its packaging are contained in documents relevant to the procurement or maintenance of the specific item.

4.2 Transportability requirements. The unit load, insofar as possible, shall be designed to move without restriction, special routing, or special escort throughout the ammunition distribution system used by the Department of Defense. See 49 CFR 170-178 and 46 CFR 146.29-180

4.2.1 Airlift compatibility. Unit loads shall conform to the general design and performance requirements of MIL-A-8421 as amplified by AFSC DH 1-11. Air transportability criteria for nuclear weapons shall conform to individual service regulations.

4.2.2 Railcar compatibility. The unit load shall, insofar as possible, be capable of being efficiently and safely loaded in standard commercial boxcars.

4.2.3 Truck trailer compatibility. Wherever practical the unit load shall be capable of being efficiently and safely loaded into standard closed van trailers capable of meeting shipping requirements for explosives. In addition, consideration shall be given to providing appropriate strength members compatible with the fixed cross member spacing in the trailers or containers authorized for Trailer on Flat Car (TOFC) or Container on Flat Car (COFC) service shown in Bureau of Explosives Pamphlet 6C.

4.2.4 Ship compatibility. Wherever the distribution system is sufficiently known to identify the type of ships to be employed, the unit load shall be capable of being safely and efficiently loaded and stowed aboard those ships. Typical shiploading situations are described by Army TM 55-607, Navy NAVSEA OP 3221.

4.2.5 Container compatibility. Wherever practical the unit load shall be capable of being safely and efficiently loaded into MILVANS and commercial ISO containers.

4.3 Handling equipment compatibility. The unit load shall be compatible with the handling equipment used throughout the expected logistic flow patterns.

4.3.1 Forklift/pallet truck capability. Unit load designs shall be capable of being handled safely by forklift trucks of rated capacity appropriate to the gross weight and geometry of the unit load. Minimum size of each forklift opening shall be 3" in height, 10" in width, with larger dimensions preferred. Full 4-way entry capability shall be provided unless a deviation is justified by life cycle cost and technical analysis. If pallet trucks are to be used in the logistic flow pattern the pallet design shall be compatible with their use.

4.3.2 Sling capability. Unit loads shall be capable of being safely handled by the authorized slings which are commonly used in ammunition stevedoring operations. Fleet issue unit loads shall also be capable of being safely handled by the authorized slings which are commonly used for underway replenishment operations.

4.4 Shape. Insofar as practical, the complete unit load shall be in the form of a rectangular parallelepiped.

4.4.1 Protrusions. Protrusions from the individual items making up the unit load shall be oriented to minimize damage. Battens, or other protective devices shall be used whenever protrusions are likely to cause damage or be damaged.

4.4.2 Item placement. Items (in or out of containers) making up the unit load shall be placed in such a way that space is utilized efficiently, the unit load meets all stability requirements, and the overhang requirements are met. ANSI MH10.1-1972 may be used for guidance in selecting specific patterns for item placement wherever appropriate.

4.4.3 Strapping placement. Strapping shall be located in such a way that it is not susceptible to snagging by adjacent unit loads, handling equipment, or transportation equipment; i.e. additional strapping, over and above that required to equal or exceed the safe working load (see 4.8.1), shall be used as necessary to insure positive retention under the conditions of the tests contained herein. Strapping shall not pass under those elements of the unit load in contact with ground unless positive steps are taken to recess the strapping to prevent frictional wear. Unsupported strapping (i.e. strapping not directly bearing on the load structure or battens) shall be kept to a minimum.

4.4.4 Item orientation. Items shall be oriented in the unit load in accordance with pertinent instructions (e.g. THIS SIDE UP) or in the least fragile position. If there are no restrictions, the items shall be oriented in the attitude which will produce the most efficient unit load dimensions. (Note: Ammunition loaded with white phosphorous (WP) shall be loaded so that the long axis of the round is vertical unless otherwise specifically authorized).

4.4.5 Drainage. To the maximum extent practical, free drainage shall be provided in the normal storage position, i.e. all depressions or pockets which could hold water should be avoided.

4.5 Size and weight. Unless the ammunition item and its shipping container are larger than the limits given herein, dimensions, size and weight shall be determined in accordance with the following:

4.5.1 Length and width. Length and width shall, insofar as practical and consistent with other dimensional rules contained herein, be close to the plan view sizes of Table 1.

4.5.1.1 Overhang. Unit loads shall be made up so as to insure stability, to provide for efficient strapping application and not to cause excessive bending force on those containers or items which may be structurally weak. When standard pallets are used (see 4.8.3) overhang in excess of 2" per edge should be avoided.

4.5.1.2 Underhang. Underhang shall not be permitted. When standard pallets are used, spacers, battens or cap assemblies shall fill out the unit load so that the overall nominal plan view dimensions are at least flush with the pallet dimensions. The strength and dimensions of the materials shall be adequate to permit shipment by all means of transport, e.g. cap assemblies shall be of such size that it will withstand all loads imposed on it by adjacent unit loads under impact conditions. When non standard pallets or skid bases are used the overall plan view size shall be tailored not to exceed the load dimensions. Skid bases shall conform to dwg #19484138.

TABLE I

RECOMMENDED UNIT LOAD DIMENSIONS FOR TRANSPORT AND STORAGE

EQUIPMENT OF FACILITY	SIZE
IGLOO MAGAZINE Minimum doorway dimensions: 48" wide X 90" high	1. One horizontal dimension should be less than 47 inches with forklift entry perpendicular to that dimension.
CONVENTIONAL VANS (40 ft) Interior size: 472" long X 92" wide X 96" high (Doorway height = 92")	1. One horizontal dimension of the unit load should be 43 to 45-1/2" to permit two wide loading to avoid lateral bracing. Three wide loading requires a horizontal dimension of 28-1/2 to 30 1/2". 2. Height should be 47" for two high loading or 31" for three-high loading.
MILVAN OR 20' X 8' ISO CONTAINERS Interior size 232" long X 92" wide X 87" high (Doorway height = 84")	1. Horizontal dimensions should be same as for conventional vans. 2. Unit load height should not exceed 41" for two high loading or 27" for three high loads.
RAILCARS (Typical) Interior size: 606" or 720" long X 100" wide X 120" high	1. One horizontal dimension should be between 52" and 54" for two wide loading without lateral bracing. Three wide loading requires a horizontal dimension from 35" to 36". 2. Height should not exceed 58" for two-high loading or 39" for three high loading.
SHIPS (Break-bulk) (No standard size)	1. Unit load design shall permit easy handling by approved slings and overhead crane.
MILITARY AIRLIFT (With 463L System) 463L Handling System Pallet: 84" X 104" (full size) 84" X 50" (half size)	1. Optimum unit load size is 42" X 52". For more information see AFSC DE 1-11 for other sizes usable.

4.5.2 Transportability limitations. Unit loads shall be designed to be economically compatible with the methods by which they will be transported or stored. Guidance concerning the preferred length, width, and height characteristics for the more common conditions is given in Table 1.

4.5.3 Gross weight. Gross weight of an ammunition unit load shall not exceed 4000 pounds unless specifically authorized by each using activity.

4.5.4 High density ammunition. Where optimization in all three dimensions produces a gross weight in excess of 4000 pounds the number of complete layers of unit packs shall be reduced until the gross weight is under 4000 pounds.

4.5.5 Special rule for amphibious assault ammunition. Certain ammunition items are intended to be used in amphibious operations. This ammunition, at least during the assault phases, must be capable of being efficiently handled in specialized ships with fixed size elevators and horizontal or vertical conveyors. Maximum dimensions for these unit loads are:

Maximum of length and width: 45 x 54 inches
Maximum Height: 44 inches
Maximum Weight: 3000 pounds

4.6 Stability. Item placement shall be such that the assembled unit load is stable on a motionless level surface without depending on strapping. This criterion shall also apply following the rough handling tests of paragraph 5.4.2 to 5.4.9 if the assembly is not distorted by more than 2 inches.

4.7 Stacking capability. Unless otherwise specified by the design activity, unit loads shall be designed to insure safe, stable, long term stacking to a height of 16 feet.

4.8 Materials. Standard parts and materials shall be used unless they are technically or economically impractical. The material used shall not adversely affect the unitized items because of incompatibility of hygroscopic or chemical properties.

4.8.1 Strapping. All strapping shall be in accordance with QQ-S-781, Class I, Type I or Type IV, Heavy Duty. Finish B is preferred unless otherwise specified by the design activity.

4.8.2 Strapping seals. All seals for metallic strapping shall be heavy duty steel in accordance with QQ-S-781, Type D, Class H, Finish A or B. Designs shall be based on the use of a single seal, double notched. Use of crimped seals is authorized with non-lubricated strapping provided two seals are used, each double crimped.

4.8.3 Pallets. Wherever practicable, and consistent with satisfying the other design and performance criteria of this standard, unit loads shall be designed to use Army pallets DA PAM 746-1, standard wood pallets, MIL-P-15011, Style I (40 X 48) or Style 1A (35 X 45-1/2) and standard steel pallets MIL-P-23312 Mk 3 Mod 0 (40 X 48) conforming to drawing 564200 or Mk 12 Mods 0 or 1 (35 X 45-1/2) conforming to drawing 2986479 or 2645217 respectively. Special purpose pallets shall be used only when they are cost effective on a life cycle basis.

4.8.4 Nails. Nails shall be in accordance with FF-N-105, Type II and of the style and size appropriate to the width and thickness of wood members being joined.

4.8.5 Staples. Staples shall be commercial grade steel of a size appropriate for the strapping used on the unit load.

4.8.6 Edge protectors. Edge protectors of a size appropriate for the strapping shall be used when specified by design activity.

4.8.7 Wood members. Lumber, in accordance with the quality requirements of MIL-STD-731 shall be used as appropriate for all structural members. Non-structural members may be fabricated from lumber in accordance with either MIL-STD-731 or MM-L-751, whichever is cost effective.

4.8.8 Plywood. Plywood shall be commercial grade C-D with exterior glue.

4.9 Markings. Important markings or inspection data on the items shall not be concealed by the unit load members. Provisions must be made or space allocated for attaching hazard marking placards to unit loads.

4.10 Fleet-Issue Unit Loads (FIUL). Unless otherwise specified, all materials used to make up fleet issue unit loads shall be non-flammable. Small lumber items may be used as spacers or battens. Metal parts shall be suitably protected from corrosion.

4.10.1 Sling compatibility. Fleet issue unit loads shall be capable of being safely handled by the authorized slings commonly used in dockside stevedoring operations and at sea connected replenishment (CONREP) and vertical replenishment (VERTREP) operations as cited below. The following slings are currently authorized for use in Department of the Navy dockside handling and transfer-at-sea operations:

<u>Sling</u>	<u>Nomenclature</u>	<u>Drawing Number</u>	<u>Area of Use</u>
Mk 70 Mod 2	Pallet Hoisting Sling	2644148	CONREP
Mk 85 Mod 0	Pallet Sling	2614969	CONREP/VERTREP
Mk 86 Mod 0	Pallet Sling	2614970	CONREP/VERTREP
Mk 87 Mod 0	Pallet Sling	2614971	CONREP/VERTREP
Mk 93 Mod 0	Pallet Sling	2642587	Dockside
Mk 100 Mod 1	Pallet Sling	2643919	CONREP/VERTREP
Mk 77 Mod 3	Container Lifting Sling	2643725	CONREP
Mk 109 Mod 0	Container Lifting Sling	2643765	CONREP
Mk 99 Mod 0	Weapons Handling Sling	2642914	CONREP
Mk 105 Mod 0	Hoisting Sling	2643482	VERTREP
Mk 105 Mod 0	Long Leg Assembly	2644390	VERTREP

5. DETAILED REQUIREMENTS

5.1 General. This section contains requirements for unit loads which shall be verified by physical tests. Prototype unit loads shall be fabricated, inspected, and tested to determine whether design meets all strength and handling requirements. Explosive loaded ammunition shall be replaced by inert items having similar physical characteristics.

5.2 Satisfactory performance criteria. The unit load shall remain intact and be capable of continued safe handling and tiering. The assembly structure (the pallet, structural or protective members, strapping, etc.) shall not fail nor permit individual parts of the unit load assembly to become unattached or separated. If the ammunition item is not protected by separate packaging or individual containers, the unit load configuration shall protect each item from damage beyond usefulness; e.g. thin structural members, fins, or other protrusions shall not be broken or deformed. If individual containers are used the unit load shall protect the containers; e.g. latches, handles, or other protrusions shall not be damaged beyond usefulness. These criteria apply only to the unit load as a whole unit. The ability of the component packages, the internal ammunition items and the pallet to withstand the hazards of transportation and storage must be determined by a separate evaluation process.

5.3 Test procedures. The prototype unit loads shall be inspected for damage after being subjected to each of the following tests in the order given.

5.4 Test temperature. Tests are normally conducted at an ambient temperature of $70^{\circ}\text{F} \pm 20^{\circ}\text{F}$ or $21^{\circ}\text{C} \pm 11^{\circ}\text{C}$. If the materials used in the fabrication of the unit load are sensitive to temperature or humidity, the tests shall be conducted at the conditions which occur in the appropriate logistic environment or as specified for testing specialized shipping containers in MIL-STD-648.

5.4.1 Stacking test. The unit load shall be loaded to simulate a stack of identical unit loads, stacked approximately 16 feet high, for a period of 1 hour minimum.

5.4.2 Repetitive shock test. This test shall be conducted in accordance with Method 5019, FED-STD-101.

5.4.2.1 Repetitive shock test (superimposed load). An alternate test which may be used when specifically required, the repetitive shock test shall be performed in its most severe transportation configurations (e.g. if the unit loads may reasonably be expected to be shipped by truck or rail three layers high, they should be tested in a configuration which simulates that condition). In this case the 1/16" feeler gauge shall be used between the top unit load and the one beneath.

5.4.3 Drop test. Fleet Issue Unit Loads shall be tested by using the Cornerwise Drop (Rotational) Test. All others shall use the Edgewise Drop Test.

5.4.3.1 Edgewise drop test. This test shall be conducted by using the procedures of Method 5008 of FED-STD-101.

5.4.3.2 Cornerwise drop (rotational) test. This test shall be conducted by using the procedures of Method 5005, FED-STD-101. The drop test shall be applied once on each bottom corner. The height of drop shall be selected from the following tabulation:

<u>Gross Wt. of Unit Load (Lbs.)</u>	<u>Ht. of Drop</u>
500 or less	24"
over 500 to 4000	18"
4000 and up	12"

5.4.4 Impact test. This test shall be conducted by using either the procedures of Method 5023 (Incline-Impact Test), or Method 5012 (Pendulum-Impact Test) of FED-STD-101. The velocity just prior to impact shall be 7 feet per second, except that Fleet Issue Unit Loads shall be impacted at 10 feet per second. The test shall be performed once on each of the four sides of the unit load. If the incline-impact procedure is used, an optional timber shall be employed which extends approximately 9" above the surface of the carriage.

5.4.5 Tipover test. This test is to be performed only if the weight and balance are such that the unit load will tip over when an edge is lifted sufficiently to form a 20-degree angle with the floor. The procedures of Method 5018 of FED-STD-101 shall be used.

5.4.6 Forklifting test. This test shall be conducted by using the procedures of Method 5011 of FED-STD-101. As an alternate procedure the forklift hazard course shown on Figure 1 may be used.

5.4.7 Pallet truck test. Unit loads which are designed to accept pallet trucks shall be lifted clear of the ground, transported a distance of at least fifty feet, and lowered. Test shall be conducted four times, i.e. forks entering the pallet from each side of the load. Any tendency for unit load to be unstable while on forks, or any difficulty in inserting or removing forks shall be cause for rejection.

5.4.8 Sling compatibility test. Unit loads utilizing special design or non-standard pallets shall be lifted, swung, lowered and otherwise handled as necessary, using slings of the types normally used for handling the unit loads under consideration. Slings shall be easily attached and removed. Danger of slippage or disengagement when load is suspended shall be cause for rejection of the unit load.

5.4.9 Disassembly test. Following all rough handling tests the unit load may be squared up within 2 inches of its original shape and on a flat level surface. The strapping shall then be cut and removed from the palletized load. Assembly of the load shall be such that it retains its unity upon removal of the strapping.

Custodian

Army - PA
Navy - OS
Air Force - 69

Preparing Activity:

Navy - OS

Project Number
8140-0406

Review Activity

Army - MJ
Navy - AS
Air Force - 69

User Activity

Army - MF, MI, SM
Navy - MC, SH

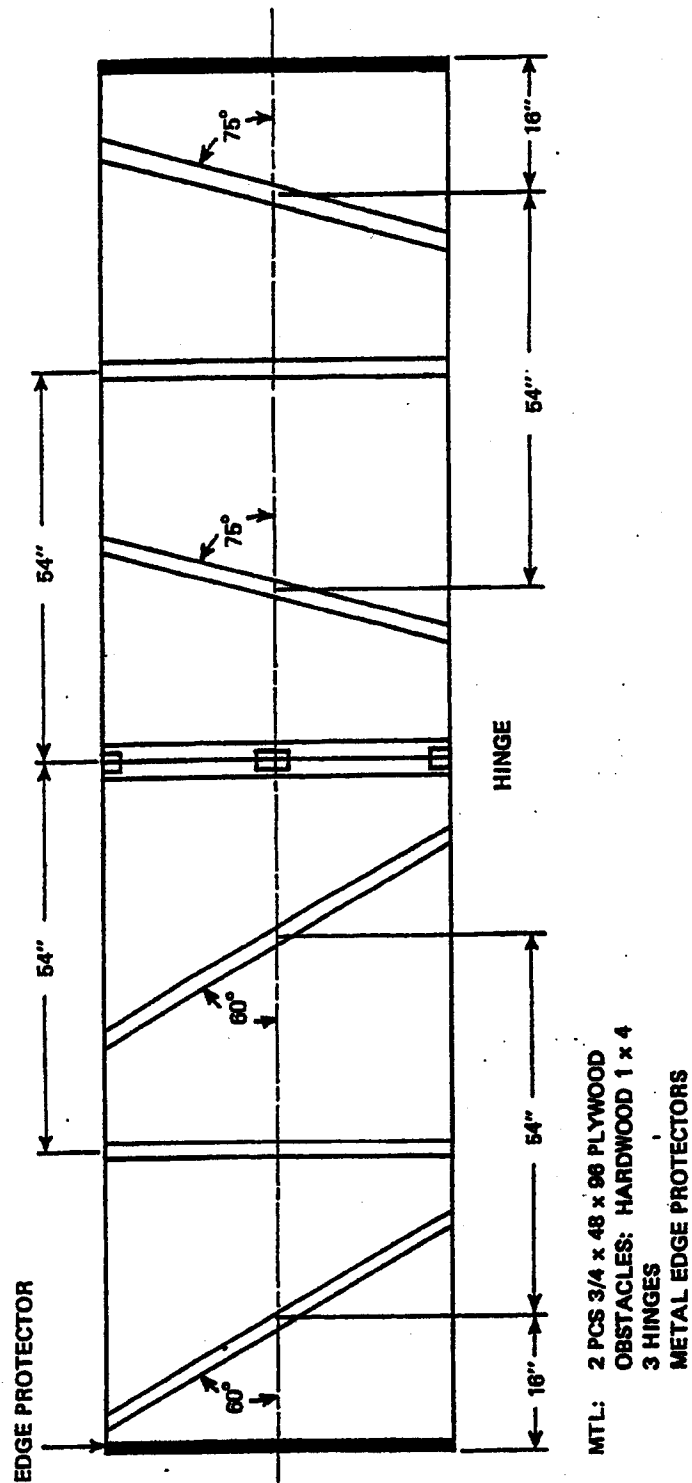
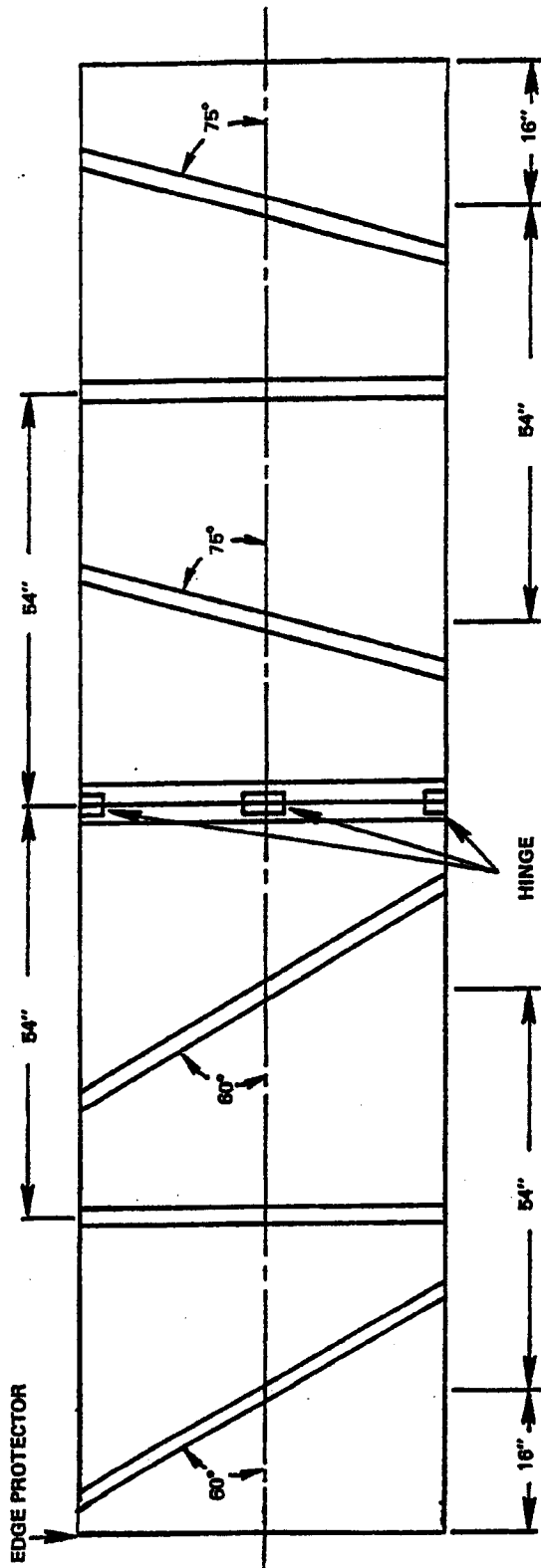


FIGURE 1. OPTIONAL ROUGH HANDLING COURSE FOR FORKLIFT TRUCKS



PLAN VIEW



SIDE VIEW

- MTL:
- 2 PCS 3/4 x 48 x 86 PLYWOOD
 - 8 OBSTACLES: HARDWOOD 1 x 4
 - 3 HINGES
 - METAL EDGE PROTECTORS
 - WOOD SCREWS ON 6" CENTERS FROM UNDERSIDE

FIGURE 1. OPTIONAL ROUGH HANDLING COURSE FOR FORKLIFT TRUCKS